

# Ultraviolet-Visible Spectrophotometry

**U**ltraviolet-visible spectrophotometry (UV-vis) of solutions measures light absorption in the range of 200 to 800 nm. A qualitative or quantitative determination of a pure organic compound is possible. Analysis for a dissolved substance via a colorimetric reaction is a highly specific quantitative method.

On-line process monitoring is possible using segmented flow spectrophotometry. Speciation and oxidation states of elements in solution, as well as structural information on conjugated organic molecules, can be obtained.

## Principle of Technique

In static spectrophotometry, the fraction of light absorbed by the liquid or compound of interest is measured at specific wavelengths. In flow spectrophotometry, the same basic principle applies except that solutions containing analyte are mixed with color-forming reagents and then passed through a spectrophotometer flow cell to record absorbances. Continuous monitoring or automatic, sequential analyses of individual solutions is possible with this technique.

## Samples

**Form.** Liquids or solids.

**Size.** Analytes must be present at millimolar concentrations in about 1 mL of solution. The exact amount depends on the analyte's extinction coefficient.

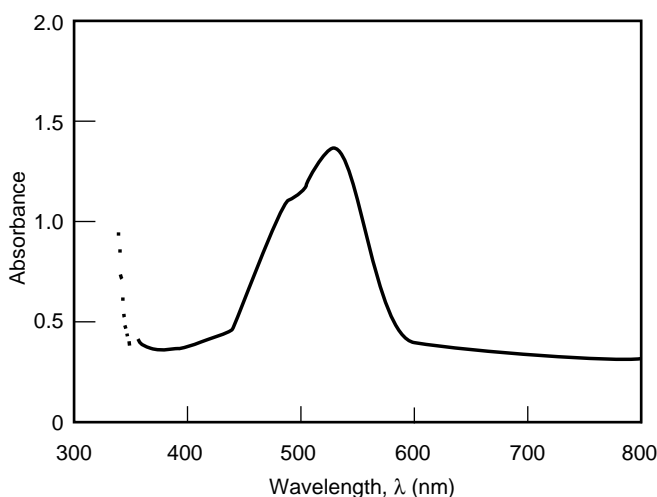
**Preparation.** Samples require dissolution and may also require reaction with a color-forming reagent.

## Limitations

The substance measured must absorb light in the 200- to 800-nm range and be free of air bubbles and solids. Precision is usually about 0.5 to 2% of the measured concentration. Limits of detection with colorimetric reagents can be as low as 0.01 ppm. Multicomponent samples usually require separation or specific reaction.

## Estimated Analysis Time

Each sample requires 15 min to 1 h if no preparation is required. Higher throughput is possible with automated flow spectrophotometry.



## Examples of Applications

- Measurement of absorbance vs wavelength of dye solutions.
- Determination of neodymium in laser glasses after dissolution in acid.
- Analysis of geothermal brine for monomeric silica.
- Use of second-derivative spectra to check for petroporphyrins in cuts from chromatography of shale oil and heavy crude oils.
- Reaction conditions optimization during preparation and extraction of non-polar uranyl complexes.
- Monitoring of alkalinity, sulfate, nitrate, and chloride in scrubber solutions.
- Nitrogen dioxide measurements on nitric acid process streams.

The monitor display of absorbance vs wavelength (or other data functions) can be saved or output to disc or tape.

Additional time may be required for preparation of standards for quantitative analysis.

#### Capabilities of Related Techniques

For determinations of low levels of metals and some nonmetals, atomic absorption spectrometry or the plasma spectrometry techniques (inductively-coupled-plasma atomic

emission spectroscopy and direct-current plasma optical emission spectrometry) are usually more convenient unless continuous monitoring is needed. These techniques do not yield speciation information.

UV-vis molecular fluorescence spectroscopy can be much more selective and sensitive but this technique is not currently available on a routine basis.